

## Inter-comparison of Upper Air Temperature in China between Satellite MSU and Radiosonde Data

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Reconciling upper-air temperature trends derived from radiosonde and satellite observations is a necessary step to confidently determine the global warming rate. This study examines the raw and homogenized radiosonde observations over China and compares them with layer-mean atmospheric temperatures derived from satellite microwave observations for the lower-troposphere (TLT), mid-troposphere (TMT), upper troposphere (TUT), and lower stratosphere (TLS) by three research groups. The comparisons are for averages over China, excluding Tibetan Plateau, and at individual stations where metadata contain information on radiosonde instrument changes. It is found that major differences between the satellite and radiosonde observations are related to artificial systematic changes. The radiosonde system updates in early 2000s over China caused significant discontinuities and led the radiosonde temperature trends to exhibit less warming in the middle and upper troposphere and more cooling in the lower stratosphere than the satellite temperatures. Homogenized radiosonde data have been further adjusted using shift-point adjustment approaches to match with satellite products for China average. The obtained trends during 1979-2015 from the re-adjusted radiosonde observation are respectively  $0.203 \pm 0.066$ ,  $0.128 \pm 0.044$ ,  $0.034 \pm 0.039$ , and  $-0.329 \pm 0.135$  K Decade<sup>-1</sup> for TLT, TMT, TUT, and TLS equivalents. Compared to satellite trends, the re-adjusted radiosonde trends are within 0.01 K Decade<sup>-1</sup> for TMT and TUT, and 0.054 K Decade<sup>-1</sup> warmer for TLT and 0.051 K Decade<sup>-1</sup> cooler for TLS. The results suggest that the use of satellite data as a reference are helpful in identifying and removing inhomogeneities of radiosonde temperatures over China and reconciling their trends to satellite microwave observations. Future efforts are to homogenize radiosonde temperatures at individual stations over China using similar approaches.

Keywords: upper air, temperature, satellite, radiosonde, China, trend

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