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FORMOSAT-3/COSMIC Temperature in the Middle Atmosphere - Comparison with SABER & MLS Temperatures and Reanalyses Data
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GPS radio occultations by FORMOSAT-3/COSMIC constellation of micro-satellites provide refractivity profiles, which are processed real-time by the COSMIC Data Analysis and Archive Center (CDAAC) at the University Corporation for Atmospheric Research (UCAR) to give profiles of temperature and water vapour in the lower atmosphere and electron density in the upper atmosphere. The 'atmprf', i.e., atmospheric profile, product gives temperature from surface to 0.2 hPa (˜ 60 km). This is a dry temperature data product that does not include relative humidity in the inversion process and hence is reliable in the stratosphere and lower mesosphere from 100 to 0.2 hPa and erroneous in the troposphere (< 100 hPa). For lower atmosphere investigations the 'wetprf' product is available which includes the relative humidity term in the data inversion process. In the current study we compare the COSMIC 'atmprf' data with other satellite temperatures (SABER/TIMED and MLS/Aura) from 50 to 0.2 hPa and reanalyses outputs (NCEP, ERA-Interim, and UKMO) at 100, 10, 1 and 0.5 hPa pressure levels. Temperature differences between seasonal medians in different latitude regions show that the COSMIC temperatures are greater than SABER temperatures by 2-3 K in the lower altitudes (> ˜5 hPa) and lower by 5-6 K at higher altitudes (< ˜1 hPa). From 5 to 1 hPa the differences change from negative to positive. This pattern is very systematic in all latitude regions and during all seasons. On the other hand, differences between COSMIC and MLS median temperatures are very small below ˜0.5 hPa and oscillate between +/- 1 K. Above ˜0.5 hPa the COSMIC temperatures are greater by 7-8 K. When compared to reanalyses outputs, COSMIC seasonal means match NCEP and ECMWF seasonal mean temperatures very well, especially at 100 and 10 hPa. The global differences are in between +/- 1 K at 100 hPa and +/- 2 K at 10 hPa. At 1 hPa the differences between COSMIC and ECMWF are greater, especially at high latitudes. On the other hand COSMIC and UKMO seasonal mean temperatures do not agree with each other except during summer and winter at lower altitudes where the differences are in between +/- 2 K. We thus conclude from this study that COSMIC temperatures obtained from radio occultations of GPS are of good quality and match very well with other satellite temperatures retrieved from limb emission measurements and also reanalyses outputs. The COSMIC mission can thus provide more data at greater temporal and spatial resolutions for further studies and investigations of the middle atmosphere. We take this opportunity to introduce this database to the middle atmosphere community for investigating the various geophysical processes in the stratosphere, stratopause, and lower mesosphere. We believe that this database would be extremely useful in investigating the planetary waves, tides, and gravity waves, and phenomenon like the sudden stratospheric warmings, double stratopause, two-way coupling of the troposphere-stratosphere-troposphere (by merging with the 'wetprf' dataset), and its effect on weather and climate, etc.

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