

The fine-scale structure of the global tropopause derived from COSMIC GPS radio occultation measurements

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The spatio-temporal structure of the lapse-rate tropopause is examined by using state-of-the-art Global Positioning System (GPS) Radio Occultation (RO) measurements from the COSMIC mission. The high temporal and spatial resolutions of the data reveal the detailed structure of tropopause properties such as pressure, temperature and sharpness, and their relationships to physical processes in the upper troposphere and lower stratosphere. In general, the overall results are in good agreement with previous studies. The climatological tropopause is largely homogeneous in the zonal direction: noticeable asymmetries are found only in the tropics and the Northern Hemisphere extratropics during boreal winter owing to localized tropospheric processes. This contrasts with the seasonal cycle of the tropopause which is significantly influenced by stratospheric processes such as the Brewer-Dobson circulation, the polar vortex, and the water vapor concentration around the tropopause. On intraseasonal time scales, tropopause pressure and temperature exhibit significant variability over the Asian summer monsoon and the subtropical regions where double tropopauses frequently occur. In contrast, tropopause sharpness shows maximum variability in the tropics where tropopause pressure and temperature have minimum variability, possibly a consequence of vertically propagating waves. The COSMIC results are also compared with NCEP-NCAR reanalysis. The reanalysis tropopause shows a systematic bias which is an order of magnitude higher than observational uncertainty estimated by the difference between COSMIC and radiosonde observations. This suggests that tropopause properties derived from reanalysis data need to be used with a great caution for any quantitative study.