Geophysical Research Abstracts
Vol. 14, EGU2012-10594, 2012
EGU General Assembly 2012

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

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The spatiotemporal structure of the lapse-rate tropopause is examined by using state-of-the-art Global Positioning System radio occultation measurements from the Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) Formosa Satellite Mission 3 mission. The high temporal and spatial resolutions of the data reveal the detailed structure of tropopause properties such as pressure (P-LRT), temperature (T-LRT), and sharpness (S-LRT) and their relationships to upper tropospheric and lower stratospheric processes.

The overall results are generally in good agreement with previous studies. The climatology of all three tropopause properties shows largely homogeneous structure 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 cycles of tropopause properties which are significantly influenced by stratospheric processes such as the Brewer[U+2010]Dobson circulation, the polar vortex, and the radiative processes near the tropopause. On intraseasonal time scales, P-LRT and T-LRT exhibit significant variability over the Asian summer monsoon and the subtropics where double tropopauses frequently occur. In contrast, S-LRT shows maximum variability in the tropics where P-LRT and T-LRT have minimum variability, possibly a consequence of vertically propagating waves.

The tropopause properties derived from COSMIC observations are further applied to evaluate tropopause data directly available from the NCEP-NCAR Reanalysis (NNR). Although the NNR tropopause data have been widely used in climate studies, they are found to have significant and systematic biases, especially in the subtropics. This suggests that the NNR tropopause data should be treated with great caution in any quantitative studies.