Vertical Distribution of Ozone at Four Sites in the United States

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We report ozonesonde observations from the following four locations across the United States: Trinidad Head, CA; Boulder, CO; Huntsville, AL, and Wallops Island, VA. The data used in this study represents ozonesondes launched between 13:00 and 20:00 GMT, covering the period between April 1995 and March 2002.

Figure 1 shows time-height cross-sections of all the data used in this study. The upper-tropospheric variability results from STE and/or larger scale meteorological/photocatalytic processes, and the boundary layer variability, especially in the summertime, results from local pollution modulated by the local weather. The profiles of Figure 2 are averaged at 50 hPa increments between 1000-100 hPa, and at 10 hPa increments between 100-10 hPa. The same average profiles were used to produce the annual cycle of the mean monthly ozone between 100-150 hPa of Figure 3.

The annual cycle of the monthly mean ozone mixing ratios (ppbv) and the coefficient of variation for the troposphere and lower stratosphere appear in the time-height cross-sections of Figure 3. The three heavy solid lines represent the monthly averaged tropopause and tropopause +/- one standard deviation calculated from the individual soundings at each of the four stations.

The seasonal cycle of ozone in the upper and middle troposphere peaks in the spring and early summer (Figure 3). In the summer, upper and middle-tropospheric ozone minima are observed; however, Trinidad Head actually decrease from their springtime high, while at the other three stations they increase toward the east.

Although they decrease substantially during the summer, the ozone coefficients of variation in the upper troposphere remain notable (40-70%). The summer coefficient of variation maximum is located almost entirely above the tropopause, with a large gradient at the tropopause. Highlighting the substantial week-to-week variability in the upper troposphere, as well as completely decoupling this variability from local stratospheric influences. Possible sources of this variability include transport of ozone previously exchanged into the upper troposphere at higher latitudes and/or on- and off-line photocatalytic production.

Throughout the stratosphere, the Huntsville profiles display more tropical character than the other three stations, a distinction most noticeable during winter and spring. In comparing the seasonal signature of ozone across the United States, eastern ozone exhibits higher tropospheric ozone concentrations as a result of local pollution effects. The seasonal cycle maximizes in the summer months at all stations except at Trinidad Head, which has the opposite phase. Huntsville experiences the highest ozone mixing ratios in the summertime convective boundary layer, reaching 75 ppbv on average in August. The other three sites experience significant vertical gradients in volume mixing ratio in the lowest 1km with surface minima.

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