Latitudinal distribution of reactive nitrogen in the free troposphere over the Pacific Ocean in late winter/early spring

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Abstract

The late winter/early spring (Feb./March, 1994) measurements of PEM-West (B) have been analyzed to show latitudinal distributions (45°N to 10°S) of the mixing ratios of reactive nitrogen species (NO, PAN, HNO_3, NO_y), O_3, and chemical tracers (CO, NMHCs, acetone, C_2Cl_4) with a focus on the upper troposphere. Mixing ratios of all species are relatively low in the warm tropical and subtropical air south of the polar jet stream (28°N) but increase sharply with latitude in the cold polar air north of the jet stream. Noteworthy is the continuous increase in reservoir species (PAN, HNO_3) and the simultaneous decrease in NO_x towards the northern midlatitudes. The Harvard global 3-D model of tropospheric chemistry has been used to compare these observations with predictions. In the upper troposphere, the magnitude and distribution of measured NO_y and PAN as a function of latitude is well represented by this model while NO_x (measured NO + model-calculated NO_2) is underpredicted especially in the tropics. Unlike several previous studies, where model-predicted HNO_3 has exceeded observations by as much as a factor of ten, the present data/model comparison is improved to within a factor of two. Except in the latitude band 20-40°N, the predicted HNO_3 is below measured values and there is little need to invoke particle reactions as a means of removing HNO_3. Comparison between measured NO_y and the sum of its three main constituents ($PAN+NO_x+HNO_3$) on average show a small mean shortfall (15%). This shortfall is attributed to the presence of known but unmeasured species (e.g., peracetic acid, alkylnitrates) as well as to instrument errors.