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


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, HNO₃, NOₓ), O₃, and chemical tracers (CO, NMHCs, acetone, C₂Cl₄) 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, HNO₃) and the simultaneous decrease in NOₓ 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 NOₓ and PAN as a function of latitude is well represented by this model while NOₓ (measured NO + model-calculated NO₂) is underpredicted especially in the tropics. Unlike several previous studies, where model-predicted HNO₃ 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 HNO₃ is below measured values and there is little need to invoke particle reactions as a means of removing HNO₃. Comparison between measured NOₓ and the sum of its three main constituents (PAN+NOₓ+HNO₃) 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.