

# Hydrogen radicals, nitrogen radicals, and the production of ozone in the middle and upper troposphere

---

Wennberg, P.O., T.F. Hanisco, L. Jaegle, D.J. Jacob, et al.

---

*Science*, 279, 49-53, 1998

---

## Abstract

The concentrations of the hydrogen radicals OH and HO<sub>2</sub> in the middle and upper troposphere were measured simultaneously with those of NO, O<sub>3</sub>, CO, H<sub>2</sub>O, CH<sub>4</sub>, non-methane hydrocarbons, and with the ultraviolet and visible radiation field. The data allow a direct examination of the processes that produce ozone in this region of the atmosphere. Comparison of the measured concentrations of OH and HO<sub>2</sub> with calculations based on their production from water vapor, ozone, and methane, demonstrate that these sources are insufficient to explain the observed radical concentrations in the upper troposphere. The photolysis of carbonyl and peroxide compounds transported to this region from the lower troposphere may provide the source of HO<sub>x</sub> required to sustain the measured abundances of these radical species. The mechanism by which NO influences the production of O<sub>3</sub> is also illustrated by these measurements. In the upper tropospheric air masses sampled, the production rate for ozone (determined from the measured concentrations of HO<sub>2</sub> and NO) is calculated to be about 1 part per billion by volume each day. This production rate is faster than previously thought, and implies that anthropogenic activities that add NO to the upper troposphere, such as biomass burning and aviation, will lead to production of more ozone than expected.

---