

# Variations of Carbon Monoxide, Methane, and Water Vapor in the Total Atmospheric Column Over Russia (Zvenigorod Station) Between 1970 and 1999

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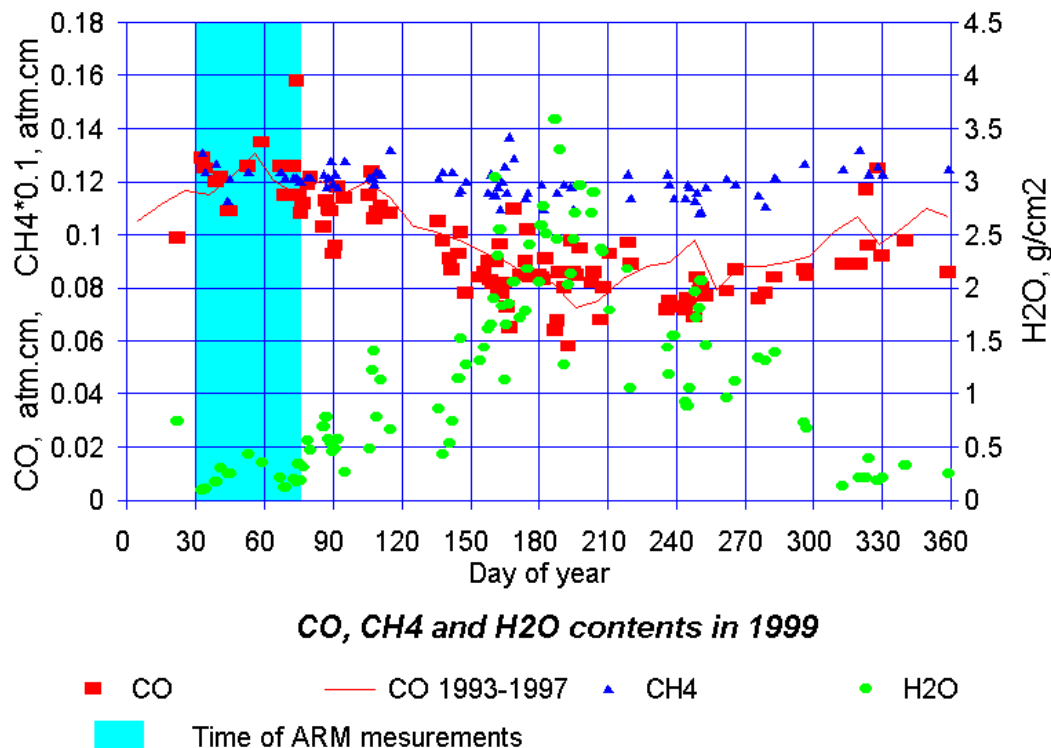
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## Introduction

The increase in the content of climate active gases in the atmosphere is one reason for climate variations. Systematic spectroscopic measurements of CO, CH<sub>4</sub>, and H<sub>2</sub>O were carried out at the Zvenigorod station of the Institute of Atmospheric Physics (IAP) RAN as well as in different expeditions, including the Arctic and Antarctic during the last 30 years (Yurganov et al. 1995, 1997; Golitsyn et al. 1991). All CO, CH<sub>4</sub>, and H<sub>2</sub>O spectroscopic measurements that are analyzed in this paper were made using an 855-mm focal length Ebert/Fastie-type spectrometer, with a 300 grooves/mm grating and a solar tracker. The spectrometer provides a resolution of nearly 0.2 cm<sup>-1</sup> in the 2,000 cm<sup>-1</sup> to 3,500 cm<sup>-1</sup> spectral region. A thermoelectrically cooled PbSe detector and PC-based data acquisition system were used. The precision of a single measurement (i.e., the standard deviation of points for a day with steady conditions) is typically 4% to 6%. Normally 20 to 30 spectra per day were observed; therefore, a statistical 1-sigma uncertainty of the daily average was about 1%. Statistical uncertainty in the monthly mean amounted to 3% to -5%.

The analysis of total-column spectroscopic CO observations revealed a positive linear trend between 1970 and 1999 of about 0.96 ppbv/yr or 0.9% per year. This rate of CO growth is almost 3 times higher than the rate between 1920 and 1950, obtained from ice core data. Sensitivities of CO mixing ratio in the troposphere to changes in total ozone and stratospheric aerosol have been assessed from the smoothed monthly measurements. Corrections due to unstable aerosol and total ozone were introduced into the experimental data. The CO trend over the entire measurement period, which would be expected under conditions of constant “undisturbed” total ozone and absence of stratospheric aerosol, would be 1.3 ppbv/yr, or 30% higher than the observed trend. A positive trend in OH concentrations between 1980 and 1999 was estimated to be  $0.6 \pm 0.3\%$ /yr. Analysis of total column CH<sub>4</sub> observations revealed a positive linear trend between 1974 and 1999 of about 0.5%/yr. A trend of H<sub>2</sub>O between 1986 and 1997 is equal to -1.1%/yr.

In the period of February 1 to March 15, 1999, the CO, CH<sub>4</sub>, and H<sub>2</sub>O contents varied between 0.09 atm.cm to 0.16 atm.cm, 1.18 atm.cm to 1.31 atm.cm, and 0.10 g/cm<sup>2</sup> to 0.58 g/cm<sup>2</sup>, respectively, which is close to their mean values for the last 5 years for these seasons (Figure 1).



**Figure 1.** Columnar contents of CO, CH<sub>4</sub>, and water vapor.

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## References

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