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Estimation of the Ozone Destruction in Clouds Derived from the Airborne Measurements

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Variations of tropospheric ozone concentration are studied based on the airborne sounding data. The chemiluminescent 3-02P (OPTEC, Russia) and two UV Model 49C (Thermo Electron Corp., USA) ozone analysers were used in these measurements simultaneously. Clouds of Cu, Cu med., St, Sc, As, and Ac types were studied. The thickness of cloud layers was 1.5 km on the average and varied from 0.4 to 4.5 km. The ozone destruction in clouds was 11–15 ppb on the average and within a range from 3 to 34 ppb. The destruction varied almost twofold depending on a cloud type.

The decrease in the ozone concentration in Cu med. exceeds those in Ac clouds by 1.75 times. The widest variation range of ozone concentration is also in Cu med. The relative variation is maximum in As clouds, it reaches 27%. The minimum one (17%) has been recorded in Cu, St, and Ac clouds; this is seemingly caused by their water content.

The given above data on variations of ozone concentration in clouds allow estimation to the first approximation of the ozone sink scales from the troposphere while interacting with cloud aerosols.

The annual mean amount of clouds over the Earth is 5.8, i.e. 58% of the surface is covered by clouds. The Earth area is 5.1 $\times$1014 m^2. During our experiments, we have obtained the thickness of cloud cover equal to 1.5 km; hence, the volume where the ozone sink occurs is 4.44$\times$1017 m^3. According to the data available, the variation of ozone concentration is 11 ppb by the “minimum” and 15 ppb by the “maximum” ozonometers, or 22 and 30 μg/m^3. Multiplying the volume by the concentration, obtain 97.6 and 133.1 Tg of ozone precipitating on aerosol particles in clouds. So obtained estimate is close to the values of annual tropospheric ozone budget and equal to 141 and 241 Tg per year.

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