

Technology and Results of Carbon Dioxide Measurements in the Air near the Ground and in the Atmospheric Column

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At the State Institution SPA “Typhoon” methods based on the principles of absorption spectroscopy were developed and systematic measurements of carbon dioxide (CO₂) in air samples taken near the ground and in the atmospheric column are carried out. The details of the measurement methods and experimental spectra processing are given in Baranov et al., *Proc. SPIE* 3983, 488-492, [1999] and Kashin et al., *Izvestiya Akad. Nauk. Fizika atmosfery i okeana (Atmospheric and Ocean Physics)* 36, (Russia) [2000]. The measurements are performed on a 300-m meteorological tower in Obninsk, Russia (55.11°N, 36.57°E, 183-m above sea level). In situ measurements of CO₂ concentration are made in air sampled from heights of 4, 25, 100, 200 and 300 m. The height-averaged concentration of CO₂ for the atmospheric column is also measured. Air samples collected once per week from the 300-m level are analyzed at CMDL.

Figure 1 gives the CO₂ concentrations measured in near-surface air during 2004. For the whole observation period the CO₂ concentrations throughout the 300-m layer were nearly the same. In the summer, CO₂ concentrations are lower in the air nearest the ground because of photosynthetic uptake by plants at the surface. Good agreement is seen between the in situ data and the results of independent analysis of air samples at CMDL.

A comparison of CO₂ concentrations measured at the 4-m level and column-averaged CO₂ concentrations (Figure 2) shows that the variations of CO₂ concentration in the air near the ground are several times greater than variations in the column-averaged values. During summer the CO₂ concentrations near the ground are always lower than the height-averaged values, and the phases of the seasonal variations differ by about a month. These results demonstrate that at continental CO₂ monitoring stations, measurements of the atmospheric column are important because large variations in the near-surface measurements are induced by ground-based sources and sinks of carbon dioxide.

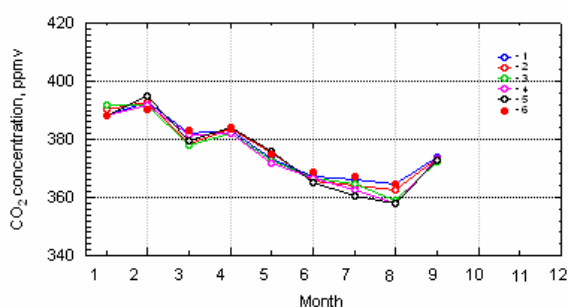


Figure 1. Seasonal variations of CO₂ at heights of 300 m (1) 200 m (2), 100 m (3), 4 m (5), and CMDL 300 m (6).

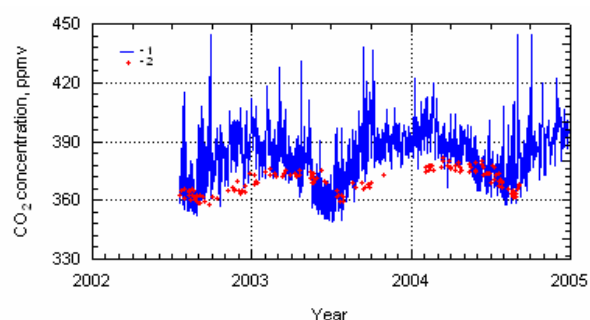


Figure 2. Comparison of CO₂ concentrations measured in air near the ground (1) and in the atmospheric column (2).

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