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西シベリアタイガにおける航空機とタワーを用いた大気境界層及び自由対流圏内の二酸化炭素濃度の長期観測（2002-2010）
Aircraft and tower measurements of carbon dioxide in the PBL and FT over taiga in West Siberia (2002-2010)

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Figure. Vertical profiles of CO_2 concentration (ppm) observed over the tower.

1. Introduction

To understand the difference in CO_2 behavior between planetary boundary layer (PBL) and free troposphere (FT) over Siberian taiga, we have conducted CO_2 measurements using a small aircraft and a tower at the taiga in West Siberia since 2002. Continuous CO_2 time series at 4 levels (5, 20, 40, and 80 m) were monitored with the tower. Up to 3 km vertical CO_2 profiles above the tower in the fine day were frequently obtained with the aircraft.

2. Method

Carbon dioxide concentrations were measured continuously at the tower located in Berezorechka village (56^{o}09N, 84^{o}20E). Sampled air from 4 levels was dehumidified and then introduced into a NDIR (LI-820, LI-COR; LI-7000 was used until September 2008). Measurement precision is +-0.3 ppm. The more detail information of the system was described in *Sasakawa et al.* [2010a]. Small CO_2 measurement device based on a NDIR (LI-800, LI-COR) equipped with flow and pressure regulation system was developed and installed in the small aircraft (Antonov An-2). Two standard gases are introduced into the NDIR every 5 minutes. Overall measurement precision is estimated to be +-0.3 ppm when we use 2 seconds averaged data. An-2 ascended to 2 km (winter) or 3 km (summer) above the tower and then descended to 0.15 km to obtain the vertical profile of CO_2 concentration. The routine aircraft measurement had been conducted basically in the afternoon with the frequency of 2-4 times per month until 2007 March despite low frequency after then.

3. Results and discussions

Figure shows the vertical profiles of CO_2 concentration observed by routine flights (261 times) from 2002 to 2010. Carbon dioxide concentrations showed slightly higher in the lower altitude during the dormant season. On the other hand, CO_2 concentration during summer gradually decreased with decrease in the altitude during summer, which implies the effect of photosynthesis by vegetation of the taiga during the growing season. The same tendency was observed in the previous years [*Machida et al.,* 2005]. Unfortunately there was no simultaneous tower data in 2010 due to equipment malfunctions.

To compare the temporal CO_2 variation between in the PBL and FT, we defined the PBL height using vertical profiles of temperature, potential temperature, and specific humidity. We found that seasonal variation of PBL height with maximum during summer (-over 3 km). Annual mean CO_2 in the PBL was always higher (approx. 2 ppm) than that in the lower FT, which is mainly due to rectifier effect. The annual means also showed an increase of 11.6 ppm (PBL) and 11.2 ppm (FT) from 2003 to 2009. We will also present diurnal variation of CO_2 vertical profiles up to 3 km observed in the summer of 2002-2004.

Generally daily minimum at the tower was observed in the afternoon when active vertical mixing occurred [*Sasakawa et al.,* 2010b]. Thus, we calculated daytime mean with averaging the data observed in 13:00-17:00 LST to compare with the data from An-2 observation. Daytime mean concentrations observed in the tower (40 and 80 m) agreed well with those in the PBL observed with An-2, which suggests that daytime tower data can be the representative values in the PBL.

References

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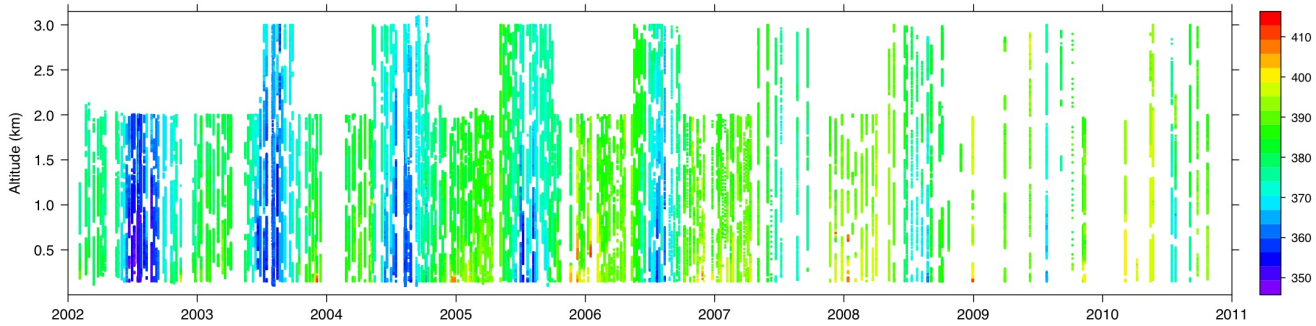

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