

Atmospheric ethane measurements over Asian cities using commercial aircraft: implications for methane emissions

*梅澤 拓^{1,2}、齊藤 拓也¹、町田 敏暢^{1,3}、丹羽 洋介¹、笹川 基樹¹、松枝 秀和⁴、澤 庸介⁵、坪井 一寛^{5,6}、石島 健太郎^{5,6}、藤田 遼⁵

*Taku Umezawa^{1,2}, Takuya Saito¹, Toshinobu Machida^{1,3}, Yosuke Niwa¹, Motoki Sasakawa¹, Hidekazu Matsueda⁴, Yousuke Sawa⁵, Kazuhiro Tsuboi^{5,6}, Kentaro Ishijima^{5,6}, Ryo Fujita⁵

1. 国立環境研究所、2. 東北大学、3. 広島大学、4. 獨協大学、5. 気象庁気象研究所、6. 気象庁

1. National Institute for Environmental Studies, 2. Tohoku University, 3. Hiroshima University, 4. Dokkyo University, 5. Meteorological Research Institute, 6. Japan Meteorological Agency

CONTRAIL (Comprehensive Observation Network for Trace gases by Airliner) is an ongoing observation program for atmospheric monitoring of greenhouse gases. Air samples have been collected onboard along international flight tracks by using an automatic air sampling equipment or a manual equipment. Some part of the air samples collected from February 2017 to September 2024 (144 flights) was analyzed for ethane (C_2H_6) in addition to the regularly measured species such as CO_2 , CH_4 and SF_6 . C_2H_6 is a useful tracer for CH_4 source attribution, for instance by utilizing characteristic natural gas composition ratio of CH_4 and C_2H_6 . We present preliminary C_2H_6 data over 4 Asian cities: Tokyo, Shanghai, Bangkok and Singapore. In the upper troposphere over Tokyo, where the data cover the longest period, C_2H_6 concentration showed neither increasing nor decreasing trend for 2017–2024. C_2H_6 increased with decreasing altitude during winter to spring, while almost no vertical gradient was observed in summer. Over Shanghai, magnitude of the C_2H_6 variability was largest. High C_2H_6 enhancements up to 6 ppb were observed in the lowermost layer (<4 km altitude) in winter coincident with CH_4 enhancement. In such events, the C_2H_6 to CH_4 enhancement ratio reached to 0.02, exceeding those observed over Tokyo and Bangkok. Over Bangkok, vertical gradient in C_2H_6 was small, but C_2H_6 and CH_4 enhancements were observed near the surface (<2 km) in winter. Elevated CH_4 values in the upper troposphere in summer (presumably associated with Asian summer monsoon) were not accompanied by increase in C_2H_6 . Over Singapore, although the data were limited (6 flights), CH_4 and C_2H_6 variabilities were small with almost no vertical gradient. In summary, the measurements showed the largest variabilities in CH_4 and C_2H_6 over Shanghai with the largest C_2H_6 to CH_4 enhancement ratio. This might be explained by higher contribution of emissions associated with natural gas leakage or coal mining in or around the city area.

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