

CUBE/Biak: Observations of dynamics and chemistry affecting the air on its ascent in the tropical lower stratosphere

F. HASEBE¹, S. AOKI², S. MORIMOTO², Y. INAI², T. NAKAZAWA², S. SUGAWARA³, C. IKEDA⁴, H. HONDA⁴, H. YAMAZAKI⁴, HALIMURRAHMAN⁵, N. KOMALA⁵, F. A. PUTRI⁵, A. BUDIYONO⁵, M. SOEDJARWO⁶, S. ISHIDOYA⁷, S. TOYODA⁸, T. SHIBATA⁹, M. HAYASHI¹⁰, N. EGUCHI¹⁰, N. NISHI¹⁰, M. FUJIWARA¹, S.-Y. OGINO¹¹, M. SHIOTANI¹², T. SUGIDACHI¹³, D. A. BELIKOV¹, and H. NGUYEN-THI¹

¹ Hokkaido University, Sapporo, Japan; ² Tohoku University, Sendai, Japan

³ Miyagi University of Education, Sendai, Japan

⁴ Japan Aerospace Exploration Agency, Sagami, Japan

⁵ LAPAN, Bandung, Indonesia; ⁶ LAPAN, Biak, Indonesia

⁷ National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

⁸ Tokyo Institute of Technology, Yokohama, Japan

⁹ Nagoya University, Nagoya, Japan; ¹⁰ Fukuoka University, Fukuoka, Japan

¹¹ Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan

¹² Kyoto University, Uji, Japan; ¹³ Meisei Electric Company, Ltd., Isesaki, Japan

Coordinated Upper-troposphere-to-stratosphere Balloon Experiment in Biak (CUBE/Biak; Hasebe et al. 2018) is a collaborative endeavor of the Cryogenic Air Sampling group, the Soundings of Ozone and Water in the Equatorial Region group, and the National Institute of Aeronautics and Space of the Republic of Indonesia (LAPAN) to investigate the physical and chemical transformation of air during its slow ascent in the Tropical Tropopause Layer (TTL) and the lower stratosphere (LS). Protected by the subtropical mixing barrier, air parcels inside the “tropical pipe” retain their identity during the ascent. However, the difference between the ascent rates estimated from mean age of air and water vapor tape recorder suggests the effect of mixing through the long tail in unobservable age spectra. The understanding of transformation of stratospheric air parcels induced by irreversible mixing will contribute to resolve the conflicting view of the long-term changes of the Brewer-Dobson circulation diagnosed from simulations of chemistry climate models and clock tracer observations (Engel et al. 2009). The first results from CUBE/Biak are published by Toyoda et al. (2018) on N₂O isotopocules and by Sugawara et al. (2018) on mean age of air and gravitational separation. In the present study, analyses are extended to investigate the processes responsible for modulating the independent ascent rate signals in the tropical LS using a single meteorological dataset and to compare them with CUBE/Biak observations.

Key words: cryogenic air sampling, water vapor tape recorder, age of air, gravitational separation, age spectra

References

Engel, A., and Coauthors, 2009: *Nature Geosci.*, **2**, 28-31.

Hasebe, F., and Coauthors, 2018: *Bull. Amer. Meteor. Soc.*, **99**, doi:10.1175/BAMS-D-16-0289.1, in press.

Sugawara, S., and Coauthors, 2018: *Atmos. Chem. Phys.*, **18**, 1819-1833.

Toyoda, S., and Coauthors, 2018: *Atmos. Chem. Phys.*, **18**, 833-844.