



Development of an incoherent broadband cavity-enhanced absorption spectroscopy (IBBCEAS) instrument for autonomous field measurements of HONO and NO₂ in a rural area

Lingshuo Meng^{1,2}, Gaoxuan Wang¹, Cécile Coeur¹, Alexandre Tomas², Tao Wu³, Hongbo Fu⁴, and Weidong Chen¹

¹Laboratoire de Physicochimie de l'Atmosphère, Université du Littoral Côte d'Opale, 59140 Dunkerque, France

²IMT Lille Douai, Univ. Lille, Département Sciences de l'Atmosphère et Génie de l'Environnement, Lille, France

³Key Laboratory of Nondestructive Test, Nanchang Hangkong University, Nanchang, China

⁴Shanghai Key Laboratory of Atmospheric Particle Pollution and Prevention, Department of Environmental Science & Engineering, Institute of Atmospheric Sciences, Fudan University, Shanghai, China

Nitrous acid (HONO) is one of the important atmospheric trace gases due to its contribution to the cycles of nitrogen oxides (NO_x) and hydrogen oxides (HO_x). In particular it acts as a precursor of tropospheric OH radicals, which is responsible for the self-cleansing capacity of the atmosphere [1,2]. We developed an instrument based on incoherent broadband cavity enhanced absorption spectroscopy (IBBCEAS) for automatic measurement of HONO in a rural area in a summer period during a field "Campagne d'OBServation Intensive des Aérosols et précurseurs à Caillouël-Crépigny (COBIACC)" in France. IBBCEAS technique is now extensively used in field applications for the measurements of both trace gases and aerosols [3,4].

Real-time in situ measurements of HONO and NO₂ have been simultaneously carried out. The IBBCEAS instrument performance has been demonstrated and validated through lab-based tests, and in particular through field intercomparison via side-by-side measurements of temporal concentration profiles of HONO and NO₂ in the rural area. The intercomparison of the concentration measurements between IBBCEAS and an instrument called MARGA (Monitor for AeRosols and Gases in Ambient air) for HONO, and IBBCEAS vs. a reference NO_x analyzer for NO₂. Good agreements have been observed which demonstrated the performance of the developed IBBCEAS instrument for the measurement of atmospheric HONO concentration (<5 ppb) in a rural area.

The preliminary experimental results will be presented and discussed.

Acknowledgments This work was supported by the CPER CLIMIBIO program and the Labex CaPPA project (ANR-10-LABX005). The authors highly appreciate the offers of Mr. Eric Wetzels from Polyfluor Plastics bv for the help in our instrumental conception involving Teflon pipe.

References

- [1] X. Li, T. Brauers, R. Häsel, R. Bohn, H. Fuchs, A. Hofzumahaus, F. Holland, S. Lou, et al., Exploring the atmospheric chemistry of nitrous acid (HONO) at a rural site in Southern China, *Atmos. Chem. Phys.* **12** (2012) 1497-1513.
- [2] H. Su, Y. Cheng, M. Shao, D. Gao, Z. Yu, L. Zeng, J. Slanina, et al., Nitrous acid (HONO) and its daytime sources at a rural site during the 2004 PRIDE-PRD experiment in China, *J. Geophys. Res.* **113** (2008) D14312.
- [3] T. Wu, Q. Zha, W. Chen, Z. Xu, T. Wang, X. He, Development and deployment of a cavity enhanced UV-LED spectrometer for measurements of atmospheric HONO and NO₂ in Hong Kong, *Atmos. Environ.* **95** (2014) 544-551.
- [4] L. Meng, G. Wang, P. Augustin, M. Fourmentin, Q. Gou, E. Fertein, T. N. Ba, C. Coeur, A. Tomas, W. Chen, Incoherent broadband cavity enhanced absorption spectroscopy-based strategy for direct measurement of aerosol extinction in lidar blind zone, *Opt. Lett.* **45** (2020) 1611-1614.